GENERAL SERIES—BULLETIN No. 2

DEPARTMENT OF AGRICULTURE
MYSORE STATE

EXPERIMENTS ON PADDY CULTIVATION

During the years 1909-11

BY

LESLIE C. COLEMAN, M.A., PH.D.,
Officer in charge,

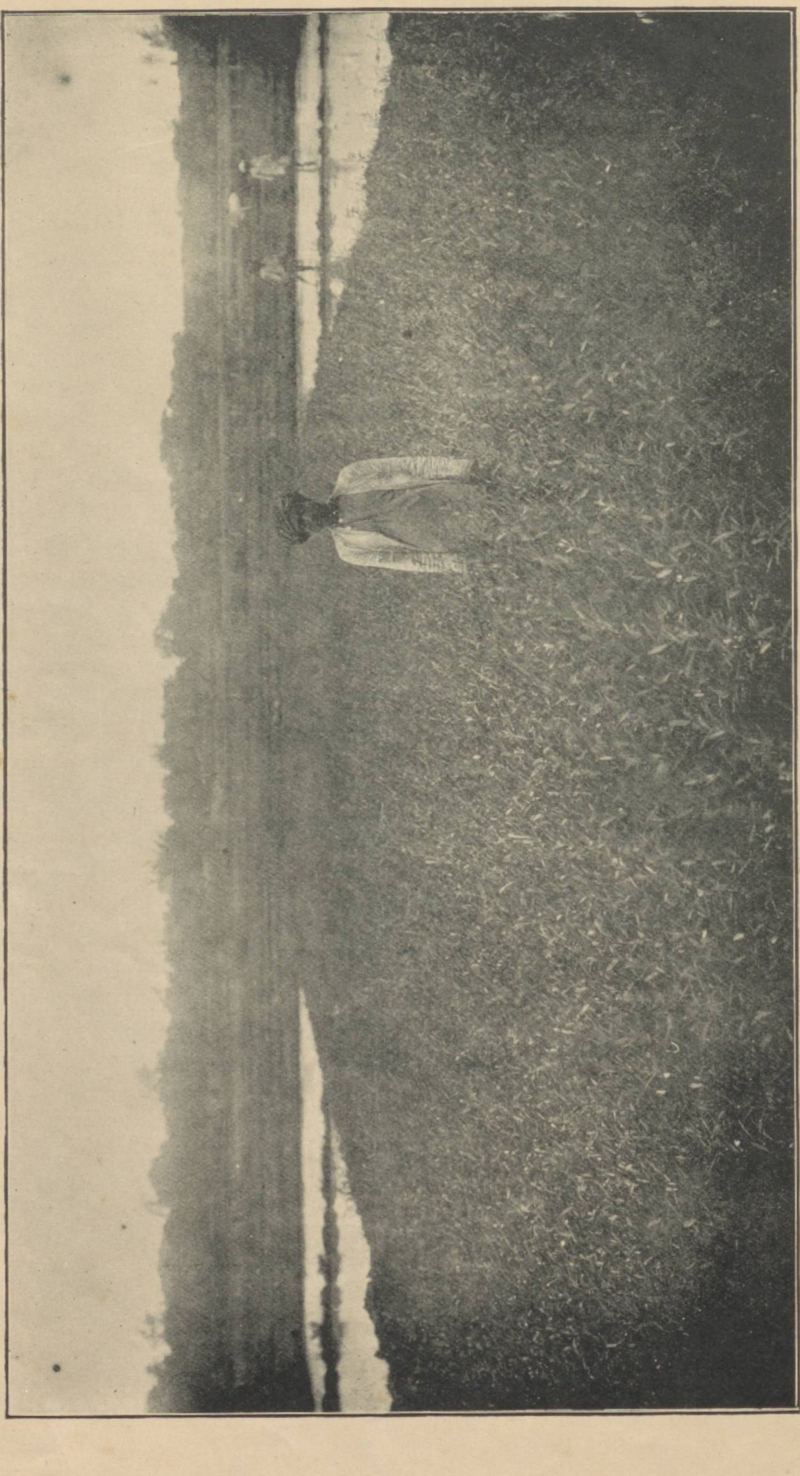
AND

D. G. RAMACHANDRA RAO,
Farm Manager.

BANGALORE:
PRINTED AT THE GOVERNMENT PRESS
1912

PRICE EIGHT ANNAS.

Plate I.



Paddy plot on Experimental Farm, showing green manure crop of sunn hemp six weeks old, about two and a-half feet high.

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18.11.16

FOREWORD.

THIS bulletin on paddy cultivation is the first of a series which is planned to contain the results of experiments carried out with the chief crops of Mysore on the Experimental Farm. Formerly these results were published in the Annual Reports of the Department; but, it has been deemed advisable to publish the results connected with each crop separately, and only after such results are sufficiently numerous and concordant to allow some practical conclusions to be drawn from them.

In the minds of many, the chief object of an Experimental Farm would seem to be simply the growing of the various crops of the State so as to produce a maximum yield. This, I may say, is an entirely erroneous view. An Experimental Farm, if properly conducted, should be utilised for growing as many of the different varieties of a given crop under as many different methods of cultivation and with as many different systems of manuring as practicable, so as to ascertain what are the most suitable varieties, the best methods of cultivation and the most economical systems of manuring for conditions existing in the State, or in that tract of the State in which the Farm is situated. Needless to say such work can be satisfactorily done only under careful scientific supervision, otherwise the results obtained are likely to be useless, or even decidedly injurious, simply because they are incorrect and misleading.

Note

After the above remarks it will, I trust, seem strange to no one that many of the results given in this bulletin show yields per acre that are quite low. In this connection it should be pointed out that the obtaining of a high yield in any crop is only desirable when the method of obtaining it is a profitable one. This, of course, has special reference to the use of manures. As will be seen in the body of the bulletin, a large increase in the yield of paddy can be obtained by the use of expensive artificial and other commercial fertilisers. When, however, we find that the cost of the manures far exceeds the value of the increase in the crop, we see, at once, that such manures cannot be recommended. In the case of paddy, as in the case of most of the ordinary crops of Mysore, the value of the produce is comparatively low and this necessitates our applying manures in the cheapest form possible. Another factor which may be only too easily overlooked is the fact that our recommendations must be applicable to raiyats and landholders whose capital is very small and who are, therefore, unable to bear a large outlay for manures, even were it established that they would thereby reap a fair return on their money.

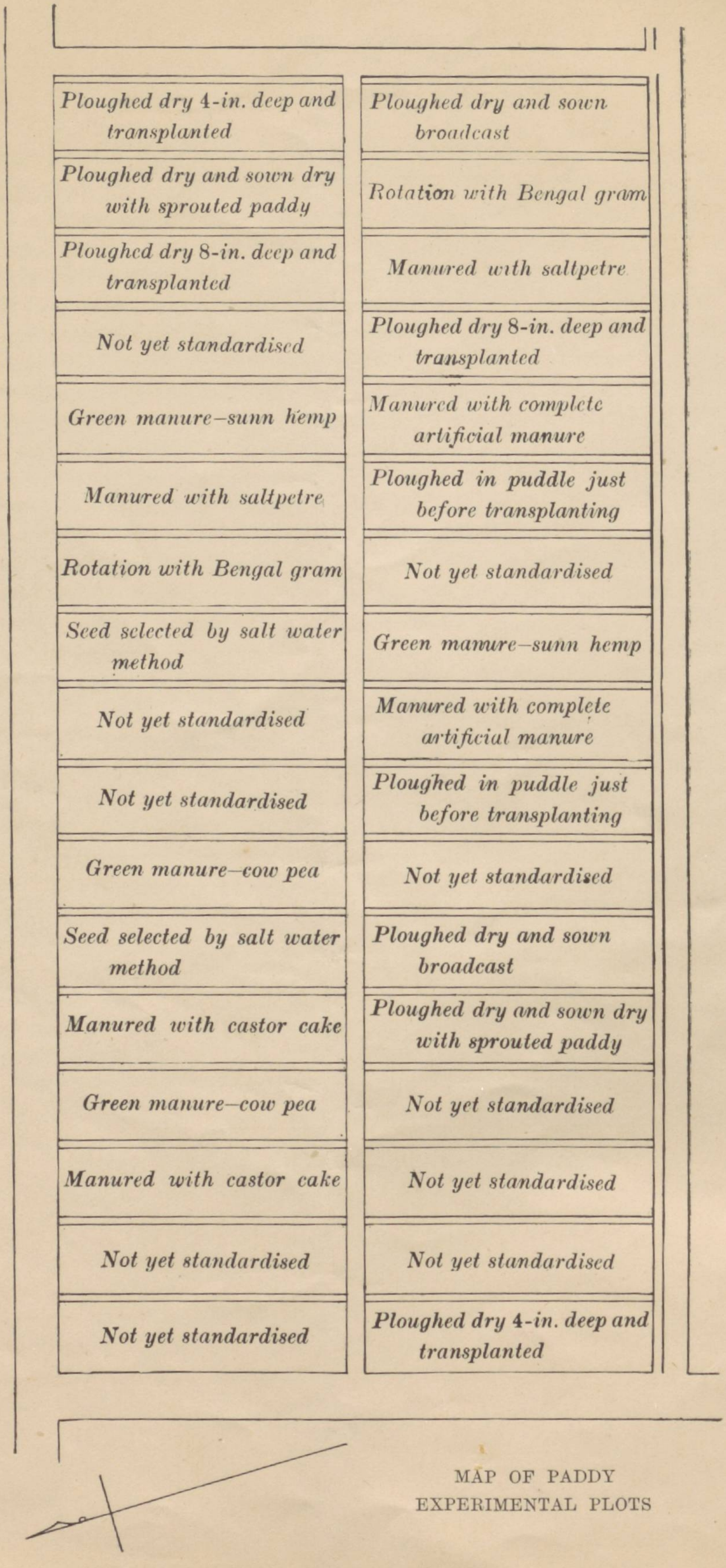
All of the above considerations have been taken into account in preparing this bulletin, and experiments which are now being planned for the future are being planned with a view to meet these conditions to the greatest extent possible.

I need hardly point out that this bulletin in no sense pretends to be an exhaustive treatise on paddy cultivation. It simply records the results of experiments already conducted with the conclusions which may properly be drawn from them. It is hoped that these conclusions will appeal to those interested in paddy cultivation in the State as being practical ones.

Demonstration work in connection with paddy cultivation has already been begun and, as will be seen in the Appendix to this bulletin, the results obtained are very promising.

BANGALORE,
February 1912.

LESLIE C. COLEMAN.



Ploughed dry 4-in. deep and transplanted	Ploughed dry and sown broadcast
Ploughed dry and sown dry with sprouted paddy	Rotation with Bengal gram
Ploughed dry 8-in. deep and transplanted	Manured with saltpetre
Not yet standardised	Ploughed dry 8-in. deep and transplanted
Green manure–sunn hemp	Manured with complete artificial manure
Manured with saltpetre	Ploughed in puddle just before transplanting
Rotation with Bengal gram	Not yet standardised
Seed selected by salt water method	Green manure–sunn hemp
Not yet standardised	Manured with complete artificial manure
Not yet standardised	Ploughed in puddle just before transplanting
Green manure–cow pea	Not yet standardised
Seed selected by salt water method	Ploughed dry and sown broadcast
Manured with castor cake	Ploughed dry and sown dry with sprouted paddy
Green manure–cow pea	Not yet standardised
Manured with castor cake	Not yet standardised
Not yet standardised	Not yet standardised
Not yet standardised	Ploughed dry 4-in. deep and transplanted

MAP OF PADDY
EXPERIMENTAL PLOTS

EXPERIMENTS ON PADDY CULTIVATION DURING THE YEARS 1909-11.

PREVIOUS to his retirement in 1908, Dr. Lehmann, formerly Agricultural Chemist to the Government of Mysore, planned certain important experiments on the cultivation of paddy. The nature of these experiments is briefly described by him in his last, or 9th, Annual Report for the year 1907-08, pages 19-21, where he also indicates the various numbered plots that are to be used for the different experiments.

These experiments have been carried on ever since his retirement and the number and character of the results obtained now warrant their being published as a bulletin of the Department.

Before recording the results obtained, it will be well for us to give a brief survey of the nature of the experiments and the character of the plots used.

In his 6th Annual Report for the year 1904-05, Dr. Lehmann has given a plan of the wet area of the Farm and, on the accompanying map (Plate II), the area set apart for paddy experiments is shown, as is also the way the plots have been used for the various experiments that have been carried out. As will be seen, the area is divided into two ranges, B and C. The individual plots contain each one-tenth of an acre, the smallest amount of land which may be considered sufficient for field experiments. The plots are fifty links wide and two hundred long and are separated from each other by permanent bunds three feet wide. These bunds have, for primary object, the prevention of the lateral spread of manures in the irrigation water. Each range and each plot can be irrigated and drained independently of the others and this practice is, of course, followed in all experiments.

Previous to beginning the experiments, five crops of paddy were grown under as similar conditions as possible to test the relative fertility of the different plots. In the case of the third crop, practically no grain was produced, a pheuomenon which has been reported from various parts of Mysore in unfavourable seasons and the cause for which is, at present, not known. The results of the remaining four crops were used in ascertaining the relative fertility of the various plots and only those plots which showed the greatest amount of uniformity in yield were used for immediate experiments. The others have since then been kept cropped under similar conditions, with the result that some more of them showed sufficient uniformity to be used for experimental purposes in 1910. As the experiments conducted on these latter plots are of great practical interest, the results of them are included in the present bulletin. The methods of standardising the experimental plots have already been discussed by Dr. Lehmann in his various reports, so nothing further need be said here on that subject.

The experiments that have, up to the present, been carried out deal with the following questions :—

1. Cultivation experiments dealing with deep and shallow ploughing, ploughing the land immediately after harvest as against leaving the land unploughed till just before transplantation, sowing sprouted seeds dry, broadcast sowing and transplantation.
2. Manurial experiments dealing with the use of artificial manures, castor poonac and green manures.
3. Rotational experiments dealing with the rotation of paddy with an unirrigated crop.
4. Seed selection by means of the so-called "salt water method."

Cultivation Experiments.

(a) *The effect of ploughing the land immediately after the crop is harvested and then puddling just before the next crop is planted as compared with that of puddling without any previous ploughing.*

The common practice in most maidan parts, especially where two crops of paddy are grown in a year, is to leave the paddy land untouched after the harvest of a crop and to plough it in puddle just before the next crop is transplanted. On the other hand, in malnad tracts the opposite practice of ploughing soon after the harvest of the crop, or at least a considerable time before the next crop is put in, commonly obtains.

General agricultural experience both in Europe and in America, especially in regions of scanty rainfall, as well as observations made in India, point clearly to the wisdom of ploughing the land some considerable time before the following crop is sown in the case of dry crops. The practice known as autumn or fall ploughing in Europe and America is an example of this. In India, the carrying out of the practice, especially on red soils, is frequently, if not generally, hindered or prevented by the fact that there is not sufficient moisture in the soil after the harvest to allow of ploughing. Experiments carried out with ragi (*Eleusine coracana*) on the dry area of the Experimental Farm here leave no doubt, however, that ploughing several months before the sowing season yields more satisfactory results than ploughing shortly before the seed is sown. Similar results have been obtained in other parts of India. Whether the advantage lies in the more thorough aëration of the soil in the former case, combined, as has been suggested by Howard, with a destruction of injurious soil organisms, remains as yet to be established. It seems probable that a more thorough storage of moisture together with a more perfect physical condition of the soil is the chief factor in accounting for the advantage of the former practice. While it might be supposed that a similar practice would be advantageous in the case of an irrigated or swamp crop such as paddy, it by no means follows of necessity that such will be the case. On the contrary, it might be supposed that, as the physical conditions in a paddy field are so different from those in a field under a dry crop, the method of preparing the soil found most suitable in the one case might prove unsuitable in the other. As a matter of fact, the accompanying results of experiments (see Table I) extending over two years show clearly that ploughing in puddle immediately before transplanting yields better results than ploughing the land some months before transplanting.

The results contained in the accompanying table call for certain comments. The yields are given in pounds of grain per acre and represent, in each case, the average from two parallel plots. The plots used for this and for all the other cultivation experiments were manured with white castor cake at the rate of 600 lbs. per acre (about 36 lbs. of nitrogen) for the first crop only. The subsequent crops received no manure and this, of course, accounts for the much lower yields in the last three crops. The reason for not manuring these crops is fairly obvious. The object of this, as of all the cultivation experiments, is to ascertain the effects of the special methods of cultivation on the crops and had manures been used there would have been danger of the effects of the cultivation being masked by the effect of the manures.

The yields in the columns marked actual are calculated directly from the actual yields of the plots. The yields in the other columns have been found by dividing the actual yields by the rates of productiveness of the corresponding plot and taking the average from the figures thus obtained. As these second results take into account the original fertility of the land, they are probably more accurate. It will, however, be noted that in each case the actual as well as the calculated yields on the plots ploughed in puddle have been in excess of those from plots that had been ploughed immediately after harvest. Where we take the actual figures, we find that in only one case (that of Chintamani Sannabhatta for 1909) is the difference comparatively slight. In this case, however, the corrected figures give a difference of 25 %.

Altogether the results must be considered as decidedly conclusive. Their conclusiveness is further established by the figures obtained for plots which were ploughed dry eight inches instead of four inches deep and which were also always inferior to those ploughed in puddle.

It may be noted here that these results are quite opposite to those originally anticipated by us and by intelligent raiyats and landholders who have been interested in following the experiments.

Lonsdale in his bulletin on "Improvements in Paddy Cultivation" (Department of Agriculture, Madras, Vol. III, Bulletin No. 61, p. 6), reaches results quite different from those obtained here. He states as follows :—

"Except on very sandy and very poor soils, the dry cultivation of wet lands has been found to have a very good effect. If ploughmen and bullocks can be spared from the work of threshing, carting grain and stacking

TABLE I.

Cultural practice	Variety Doddabile[1]								Variety Chintamani Sannabhatta[2]							
	1909[3]				1910[4]				1910[5]				1911[5]			
	Yield per acre, average of two plots actual	Increase per cent	Yield per acre, average of two plots calculated on fertility ratio	Increase per cent	Yield per acre, average of two plots actual	Increase per cent	Yield per acre, average of two plots calculated on fertility ratio	Increase per cent	Yield per acre, average of two plots actual	Increase per cent	Yield per acre, average of two plots calculated on fertility ratio	Increase per cent	Yield per acre, average of two plots actual	Increase per cent	Yield per acre, average of two plots calculated on fertility ratio	Increase per cent
1. Ploughed dry 4 in. deep, immediately after harvest (*i.e.*, 1-4 months before transplantation)	2,257	...	2,140	...	895	...	820	...	1,195	...	1,120	...	1,133	...	1,110	...
2. Ploughed in puddle just before transplantation	2,417	7	2,750	28·5	1,082	20·9	1,210	47·5	1,225	2·5	1,400	25	1,370	20·9	1,560	40·5

[1] Doddabile paddy is a variety commonly grown near Bangalore during the wet season, July and January.
[2] Chintamani Sannabhatta is a variety commonly grown near Bangalore during the dry season, February to July.
[3] In the case of this crop, the land was ploughed four months before transplantation.
[4] In the case of this crop, the land was ploughed one month before transplantation.
[5] In the case of these crops, the land was ploughed two months before transplantation

straw, the plots are ploughed immediately the crop is taken off the ground, provided the soil is not already too hard. If this cannot be done, the land which is not cultivated with Kar crop paddy, is ploughed whenever there is an opportunity after the occasional showers which fall from the beginnings of April to the end of September. The main effects of this dry cultivation are:—

"(*a*) More plant food is rendered available for the succeeding crop.

"(*b*) The air gets into the soil which enables the roots of the paddy to go down deeper, thus making it less subject to drought and increasing the area from which the plant obtains its food supply.

"(*c*) Weeds are destroyed."

It is to be regretted that Lonsdale does not give any of the data upon which he bases these recommendations and conclusions. Nor does he state whether different results in this regard have been obtained with different varieties of paddy. It seems quite possible that, with some of the so-called dry land paddies, which require much less water for irrigation, better results might be obtained by aërating the soil in the way suggested. The soil in the paddy plots of the Experimental Farm here is not very sandy nor is it naturally poor although continued cropping without the addition of manure, as has been done in these particular experiments on the Farm, has, of course, tended to reduce the yield greatly.

In this connection, it is interesting to note certain results obtained by the Madras Department of Agriculture on their Experimental Farm at Samalkota. (Scientific Report of the Samalkota Agricultural Station for 1909-10, p. 17.) This report states: "A new experiment to test the effect of puddling was carried on in Fields Nos. 28 and 29. Owing to shortage of cattle labour at the time of transplanting, fields are occasionally ploughed dry and, when water is available, it is simply let into the field and transplanting is done without further puddling. Comparison of this system, which is not resorted to except in special cases, shows its inferiority to the system of ploughing the land in puddle and subsequently transplanting." The report gives no information as to how long this dry ploughing was done before the transplanting took place, while the experiment differs from the experiment carried on here in that no puddling was done before transplanting on the previously ploughed land. However, the results are quite in accordance with those obtained here and do not agree at all with Lonsdale's conclusions cited above.

There remains, it seems to us, no doubt that, under the conditions existing in most parts of Mysore at least, dry ploughing of paddy land long before transplantation will not yield so good results as leaving the land unploughed until the transplanting season and then ploughing in puddle. We have now to consider the possible causes for this marked difference.

In seeking for a cause for this difference, we must consider all the possible differences which could have been produced in the two series of plots under the different treatments. Firstly, where the land is left unploughed until the transplanting season, opportunity is afforded for the growth of weeds on the plots and these, when puddling takes place, go to increase the organic matter in the soil. The amount of organic material thus added is, however, comparatively little and, under the conditions obtaining in these experiments, cannot have amounted to more than a few hundred pounds per acre and it is extremely doubtful whether this would account, at the most, for more than a very small fraction of the difference in yields noted above. Whether, on the other hand, the dry ploughing and accompanying aëration has had any effect on the humus content of the soil is a matter that can be settled only by chemical analysis. Analyses of samples taken from the two series of plots as regards humus content have yielded the following results:—

Plot	B 8	(untouched till puddling)	0·63 %	humus
,,	B 12	(do do)	0·41 %	,,
,,	B 14	(dry ploughed after harvest)	0·53 %	,,
,,	C 13	(do do)	0·50 %	,,

From this, it appears that the amount of humus is comparatively low in all the plots and no appreciable difference exists in the humus content of the two series of plots. We see, then, that the injurious effects of ploughing paddy land immediately after harvest is not due to a greater destruction of humus resulting therefrom.

Secondly, it might be supposed that the conditions on the ploughed plots have favoured the formation of greater quantities of soluble matter than are formed on those left unploughed. If this were the case, there would, of course, be a greater amount of leaching in the case of these plots when they are flooded and drained. This would, in turn, lead to a more rapid impoverishment of the plots than would take place on the unploughed ones. If this actually plays an important rôle in producing the differences of yield, we should expect to find the differences between the two series of plots increasing as successive crops are taken off. We do not, however, find any evidence of such increase. In fact the results would seem to indicate that the differences are becoming less rather than greater. Thus we find the difference in yield for Doddabile paddy less in 1910 than in 1909 and the same is the case for Chintamani Sannabhatta. Samples taken from the plots of the two series have given the following results as regards the amount of soluble matter :—

		Water soluble matter
Plot	B 8 (untouched till puddling)	0·44 %
,,	B 12 (do do)	0·38 %
,,	B 14 (dry ploughed immediately after harvest)	0·27 %
,,	C 15 (do do)	0·15 %

Here again we find comparatively little difference between the two series of plots. Contrary to expectation, we find more water-soluble matter in the soil left untouched than in that ploughed immediately after harvest.

Finally, it seems quite probable that one of the chief factors in producing the difference in the yield is the alteration in the bacterial content of the soil produced by ploughing it some time before transplanting. Soil Bacteriology is a new science upon which very little work has been done in India. The work on this subject in Europe and America during the last few years has shown, beyond a doubt, that the micro-organisms of the soil are of immense importance to the agriculturist. To them, as to no other factor, is due the maintenance of soil fertility, especially with regard to the supply of nitrogen. The soil organisms are, however, by no means all beneficial and, under some conditions, certain ones among them may be the cause of serious losses of plant food, while others give rise to very serious plant diseases.

Practically nothing is known with regard to the organisms that are active in paddy soils when those soils are under cultivation and are flooded with water. It seems fairly clear, however, that, under such conditions, the organisms most active in converting manurial and soil constituents into materials most suitable as food for the paddy plant will be quite different from those that are active in dry land soils. That paddy differs decidedly in its food requirements from most dry land crops seems highly probable. Kellner[1] and other workers in Japan have shown that nitrates are formed in paddy soils only very slowly if at all. Their work as well as that of Kelly[2] in Hawaii goes to show that paddy does not normally take up nitrogen in the form of nitrates but in the form of ammonia, which is, of course, just the opposite to what normally takes place in the case of dry land crops.

If, then, the conditions that normally obtain in dry soils are not to be found in paddy soils and if a process such as nitrification, which is almost universally active in dry soils, is entirely or almost entirely inhibited in paddy soils, we might expect that a sudden change such as must result from ploughing up and exposing paddy soils for long periods to sun and air might have a detrimental effect on the micro-flora of the paddy land from which it would take some time to recover. Whether this is the really important factor in producing the differences which are clearly brought out in this experiment could be definitely decided only after a careful and prolonged bacteriological study of paddy lands and this must be postponed till a larger staff is available for experimental work.

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[1] The work of investigators in Japan on paddy cultivation is of great value and has received too little consideration at the hands of workers who have been engaged in a study of this crop in India. The chief papers published describing the Japanese experiments are the following :—

(1) Kellner—Agricultural Chemical Studies on Rice Cultivation (Agriculturchemische Studien über Reiscultur), Landwirtschaftliche Versuchsstationen, Vol. 30, p. 18, 1884.

(2) Kellner, Kozai, Mori and Nagaoka—Manurial Experiments with Rice (Düngungs-Versuche mit Reis), Landwirtschaftliche Versuchsstationen, Vol. 39, p. 361, 1891 and Vol. 41, p. 295, 1892.

(3) Kellner, Bulletin No. 9, 1891, College of Agriculture, Imperial University, Tokyo.

(4) Nagaoka, Bulletin No. 6, 1904, College of Agriculture, Imperial University, Tokyo.

(5) Daikuharu and Imaseki, Bulletin of the Imperial Centr. Agr. Expt. Station, Japan, Vol. 1, No. 2, p. 7, 1907.

[2] Kelly, The Assimilation of Nitrogen by Rice, Bulletin No. 24, Hawaii Agricultural Expt. Station, 1911. This bulletin, in addition to valuable original work, contains an up-to-date summary of the work that has been done on the subject of the nitrogen nutrition of paddy.

(b) The effect of deep ploughing as compared with shallow ploughing on paddy lands.

As Dr. Lehmann notes in his 9th Annual Report, p. 21, this experiment was begun on account of his having noticed very marked differences in the growth of paddy where the soil had been dug deep as compared with that under ordinary cultivation.

In the deep ploughed plots, the land was ploughed to a depth of eight inches with an improved plough. The other plots that are to be compared with these are the ones which are mentioned in the table on page 5 as having been ploughed to a depth of four inches. The results from these two series of plots are given in Table II on page 11.

As has already been stated, the deeper ploughing has shown no uniformly or markedly better results than the shallower. In two of the crops, the shallow ploughed plots have yielded better results, in one (the first crop) the difference is very slight, while, in the last crop, the deep ploughed plots have given decidedly higher yields. In the light of these conflicting results, deep ploughing of paddy lands cannot, at present, be recommended as a general practice. As neither deep nor shallow ploughing long before transplantation has yielded as good results as ploughing in puddle just before transplantation, the latter practice must be recommended as a general cultural method in most of those parts where it is not now practiced. It must not be supposed, from the above, that improved ploughs which invert the soil, are not useful on paddy lands. They are, in fact, of decided advantage, especially in cases where green manures and leaf manure have to be ploughed in, as the work can be done decidedly more rapidly and more effectively with them than with the ordinary country plough.

(c) Broadcast sowing as compared with transplantation.

Both of these methods of sowing paddy are commonly practiced in Mysore, while drilling of the seed is also frequently done. It may be said, in a general way, that transplanting is the more common method of

TABLE II.

Nature of cultivation	Variety Doddabile								Variety Chintamani Sannabhatta							
	1909				1910				1910				1911			
	Yield of grain per acre, average of two plots actual	Percentage increase	Yield of grain per acre, average of two plots calculated on fertility ratio	Percentage increase	Yield of grain per acre, average of two plots actual	Percentage increase	Yield of grain per acre, average of two plots calculated on fertility ratio	Percentage increase	Yield of grain per acre, average of two plots actual	Percentage increase	Yield of grain per acre, average of two plots calculated on fertility ratio	Percentage increase	Yield of grain per acre, average of two plots actual	Percentage increase	Yield of grain per acre, average of two plots calculated on fertility ratio	Percentage increase
1. Ploughed 4 in. deep immediately after harvest (*i.e.*, 1-4 months before transplantation.)	2,257	12	2,140	...	895	57	820	26	1,195	37	1,120	10	1,133	...	1,110	...
2. Ploughed 8 in. deep immediately after harvest *i.e.*, 1-4 months before transplantation.)	1,987	...	2,240	4·7	570	...	650	...	890	...	1,020	...	1,340	18	1,530	38

planting in the eastern part of the State while broad-casting and drilling are almost universally practiced in the malnad and semi-malnad portions. There are various advantages attached to transplantation irrespective of its effect on the yield. Thus, where rationally practiced, it allows for a very great saving in the seed used and does away with all necessity for waste of seed in the thinning process which always follows broad-casting or drilling. In addition, it allows of the growth of a green manure crop on the land even where two crops of paddy are raised in the year, as on the Experimental Farm here, something which would be quite impossible were broad-casting or drilling resorted to. As against these manifest advantages, we have the disadvantage of the greater amount of labour required for transplantation. Not only does the actual planting take a longer time, but we have in addition the preparation and sowing of the nursery. This is undoubtedly one of the chief reasons for its not being more extensively practiced in malnad and semi-malnad parts where agricultural labourers are often difficult to obtain.

In connection with a discussion of the practice of transplantation, it must be noted here that the method usually followed is anything but a rational one. Raiyats and land-holders, when asked the number of seedlings transplanted in a single bunch in their fields, usually estimate it at about five or six. Were this actually the case, the amount of seed used per acre would be decidedly too great, but actual counts of bunches of freshly transplanted seedlings have shown fifteen and twenty per bunch as no exception. It is clear, then, that the raiyat, in most places, uses at least ten times as much seed per acre as he should, while a still greater waste of seed in transplantation is frequently to be found.

There is by no means a unanimity of opinion as to the superiority of single seedling transplantation over the use of two or three seedlings. In the experiments on the farm, two have been transplanted together.

The results of broad-casting as compared with transplanting for four successive crops are given in Table III, page 13.

These results show a fairly marked increase in favor of the transplanting in one of the four crops; in two, the results show very little difference while in one broad-casting

TABLE III.

Cultural practice	Variety Doddabile								Variety Chintamani Sannabhatta							
	1909				1910				1910				1911			
	Actual yield in lbs. per acre	Percentage increase by trans-planting or broad-casting	Yield per acre calculated on fertility ratio	Percentage increase by trans-planting or broad-casting	Actual yield in lbs. per acre	Percentage increase by trans-planting or broad-casting	Yield per acre calculated on fertility ratio	Percentage increase by trans-planting or broad-casting	Actual yield in lbs. per acre	Percentage increase by trans-planting or broad-casting	Yield per acre calculated on fertility ratio	Percentage increase by trans-planting or broad-casting	Actual yield in lbs. per acre	Percentage increase by trans-planting or broad-casting	Yield per acre calculated on fertility ratio	Percentage increase by trans-planting or broad-casting
Ploughed dry and broad-casted	2,060	3·6	2,160	...	675	18	650	...	1,205	35	1,160	14	1,015	...	1,150	...
Ploughed dry and transplanted	1,987	...	2,240	4	570	...	650	...	890	...	1,020	...	1,340	31	1,530	33

has given better results. It must be remembered that in both these series the practice of ploughing the land dry after harvest has been followed. It seems quite possible that the difference from the two systems of sowing would have been more marked had the land been ploughed just before sowing and transplantation respectively. In the case of both varieties, the difference has been more marked in the second year than in the first. A fact of some importance, which is not brought out in the figures is that, in the case of broad-casting, there is decided danger of faulty germination and there has been decidedly greater difference between the parallel plots of the broad-casted series than between those of the transplanted series. On the whole, the results may be said to indicate the superiority of transplanting over broad-casting. Whether, however, the difference will pay for the additional labor in transplanting will depend, partly at least, upon how readily available labor is. A series of demonstrations of transplantation now in progress in Kadur and Shimoga Districts should enable us to decide with a fair degree of accuracy just how profitable this practice will be in the western part of the State where it is not now practiced to any appreciable extent.[1]

In the above experiment, the broad-casting was done with sprouted seed and on the wet land.

An additional set of duplicate plots has been used for broad-cast sowing sprouted paddy seed on the dry land previous to irrigation. These have yielded throughout results uniformly and decidedly inferior to those obtained by broad-casting sprouted seeds on wet land as indicated in the following Table IV. This experiment will now be dropped.

MANURIAL EXPERIMENTS WITH PADDY.

The manures that have been tested are (*a*) green manure—sunn hemp (*Crotolaria juncea*), (*b*) castor cake, 600 lbs. per acre, (*c*) saltpetre, 300 lbs. per acre, (*d*) complete artificial fertiliser consisting of basic slag, 300 lbs. per acre, potassium sulphate, 120 lbs. per acre and saltpetre,

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[1] See Appendix for the results of these demonstrations as far as they are available at the time of issue of this bulletin.

TABLE IV.

Cultural practice	Variety Doddabile								Variety Chintamani-Sannabhatta							
	1909				1910				1910				1911			
	Actual yield per acre in lbs.	Percentage decrease by sowing dry	Yield per acre calculated on fertility ratio	Percentage decrease by sowing dry	Actual yield in lbs. per acre	Percentage decrease by sowing dry	Yield per acre calculated on fertility ratio	Percentage decrease by sowing dry	Actual yield per acre in lbs.	Percentage decrease by sowing dry	Yield per acre calculated on fertility ratio	Percentage decrease by sowing dry	Actual yield in lbs. per acre	Percentage decrease by sowing dry	Yield per acre calculated on fertility ratio	Percentage decrease by sowing dry
Ploughed dry and sown broad-cast with unsprouted seed on wet ground	2,060		2,160		690		650		1,205		1,160		1,015		950	
Ploughed dry and sown broad-cast with sprouted seed on dry ground	1,767	14·2	1,770	18	480	30·4	470	27·7	995	17·4	980	15·5	685	32·5	640	32·6

300 lbs. per acre. This complete fertiliser, in addition to supplying the three chief plant food ingredients necessary in manure, *viz.*, phosphoric acid, potash and nitrogen, also supplies a considerable quantity of lime (in the basic slag). For the first crop, we have no unmanured plot with which to compare these manurial plots, as all those which had been used for cultivation experiments were manured with white castor cake at the rate of 600 lbs. per acre. For the following three crops, unmanured plots were available although, no doubt, the residual effect of the original manuring with castor cake must have remained to a certain extent for at least one season. The results are brought together in Table V.

If we examine these results, we find that castor has proved the most efficient of all the manures used, with the exception of one crop (Doddabile paddy, 1910) where the results have been unaccountably low. As, however, white castor is an expensive manure costing from Rs. 55 to Rs. 60 per ton, the increase must be very considerable to make the use of this manure profitable for a crop such as paddy.

As, during the first season, all the plots were manured, we have no means of judging whether it was profitable or not although it seems probable that it was so. For the other crops, the profit or loss by the use of castor as a manure is shown in Tables VI and VII as is that in the case of the other manures that have been used.

In these tables the cost of the manures has been taken from the actual prices paid by the Department, while the value of the increased yields has been calculated on the actual market price of the variety of paddy during the season under experiment. These latter figures have been obtained from a leading grain merchant in Bangalore City. They are probably slightly in excess of the actual prices received by raiyats.

If we, first of all, examine the results obtained from the actual yields, we find that the greatest increase per acre in grain has been produced by the use of castor manure. This has given an increase of 520 lbs. of grain per acre for one crop of Doddabile paddy and an average increase of 1,025 lbs. per acre for two crops of Chintamani Sannabhatta. When we take into account the cost of the manure on the one hand and the value of the increase in grain on the other, we find there has been a slight loss on the first

TABLE V.

RESULTS OF MANURIAL EXPERIMENTS.

Manures used and rate per acre	Variety Doddabile				Variety Chintamani Sannabhatta							
	1910				1910				1911			
	Yield in lbs. of grain per acre, average of 2 plots actual	Per cent of increase	Yield in lbs. of grain per acre, average of 2 plots calculated on fertility ratio	Per cent of increase	Yield in lbs. of grain per acre, average of 2 plots actual	Per cent of increase.	Yield in lbs. of grain per acre, average of 2 plots calculated on fertility ratio	Per cent of increase	Yield in lbs. of grain per acre, average of 2 plots actual	Per cent of increase	Yield in lbs. of grain per acre, average of 2 plots calculated on fertility ratio	Per cent of increase
Unmanured ...	570	...	650	...	890	...	1,020	...	1,340	...	1,530	...
Castor, 600 lbs. per acre.	1,090	91	990	52	2,330	162	2,120	108	1,950	46	1,770	15
Sunn hemp ...	1,005	76	1,160	78	1,155	30	1,330	30	1,170	—13	1,350	—12
Saltpetre, 300 lbs. per acre.	730	28	830	27	967	9	1,090	7	1,340	...	1,520	...
Complete fertiliser :- Basic slag 300 lbs., Saltpetre 300 lbs., Potassium sulphate 120 lbs. per acre.	1,210	112	1,380	112	1,445	62	1,650	62	1,650	23	1,900	24

TABLE VI.

Manures used with quantity per acre	Cost per acre	Value of increase or decrease of crop over unmanured plots			Profit or loss per acre		
		Doddabile, 1910 (a)	Chintamani Sannabhatta		(a)	(b)	(c)
			1910 (b)	1911 (c)			
		Actual increase in yield per acre with value.					
Castor, 600 lbs. ...	Rs. 15-0-0	520 lbs. Rs. 11-13-0	1,440 lbs. Rs. 39-12-0	610 lbs. Rs. 18-0-0	Rs. —3-3-0	Rs. 24-12-0 *Rs. 24-9-0	Rs. 3-0 0
Sunn hemp ...	Rs. 3-0 0	435 lbs. Rs. 9-14-0	265 lbs. Rs. 7-0-0	—170 lbs. Rs. 5-0-0	Rs. 6-14-0	Rs. 4-0-0 *Rs. 2-14-0	Rs. —8-0-0
Saltpetre, 300 lbs. ..	Rs. 26-0-0 in 1910 and Rs. 27-8-0 in 1911	60 lbs. Re. 1-1-0	77 lbs. Re. 1-11-0	....	Rs. —24-15-0	Rs. —24-5-0 †Rs. 76-12-0	Rs. —27-8-0
Complete fertiliser:— lbs. Basic slag 300 Saltpetre 300 Potassium sulphate 120	Rs. 43-0-0 in 1910 and Rs. 47-9-0 in 1911	640 lbs. Rs. 14-11-0	555 lbs. Rs. 15-0-0	310 lbs. Rs. 9-0-0	Rs. —28-5-0	Rs. —28-0-0 †Rs. 94-14-0	Rs. —38-9-0

* Total profit on three crops. † Total loss on three crops.

TABLE VII.

Manures used with quantity per acre	Cost per acre	Value of increase or decrease of crop over unmanured plots			Profit or loss per acre		
		Doddabile, 1910 (a)	Chintamani Sannabhatta		(a)	(b)	(c)
			1910 (b)	1911 (c)			
		Calculated increase in yield per acre with value.					
Castor, 600 lbs. ...	Rs. 15-0-0	340 lbs.	1,100 lbs.	240 lbs.	Rs. —7-4-0	Rs. 15-9-0	Rs. —7-15-0
		Rs. 7-12-0	Rs. 30 9-0	Rs. 7-1-0		*Re. 0-6-0	
Sunn hemp	Rs. 3-0-0	510 lbs.	310 lbs.	—180 lbs.	Rs. 8-9-0	Rs. 5-8-0	Rs. —8-4-0
		Rs. 11-9-0	Rs. 8-8-0	Rs. —5-4-0		*Rs. 5-13-0	
Saltpetre, 300 lbs. ...	Rs. 26-0-0 in 1910 and Rs. 27-8-0 in 1911	180 lbs.	70 lbs.	—10 lbs.	Rs.—22-0-0	Rs. —24-3-0	Rs. —27-8-0
		Rs. 4-0-0	Re. 1-13-0	......		†R 73-11-0	
Complete fertiliser:— lbs.							
Basic slag ... 300	Rs. 43-0-0 in 1910 and Rs. 47-9-0 in 1911	730 lbs.	630 lbs.	370 lbs.	Rs.—26-7-0	Rs.—25-8-0	Rs. —36-11-0
Saltpetre ... 300		Rs. 16-9-0	Rs. 17-8-0	Rs. 10-14-0		†Rs. 88-10-0	
Potassium sulphate 120							

* Total profit on three crops. † Total loss on three crops.

crop, a large gain on the second and a slight gain on the third giving a total profit of Rs. 24-9-0 per acre on the three crops together.

The next greatest increase has been produced by the use of the complete artificial fertiliser which has given an increase of 640 lbs. of grain per acre for one crop of Dodbile paddy and an average increase of 427 lbs. of grain per acre for two crops of Chintamani Sannabhatta. When, however, we compare the cost of the manure with the value of the increase of crop, we find that there has been a large loss in each case, giving a total loss of Rs. 94-14-0 per acre for the three crops.

Next in order comes the effect of the green manure. This has given a decided increase in outturn in the case of the one crop of the Doddabile paddy and in one of the two crops of Chintamani Sannabhatta. In the other there has been a slight loss. There has, however, been a total gain of about Rs. 3 per acre as a result of the three crops.[1] It must be emphasized that these green manure crops were grown under particularly unfavorable conditions with the result that only comparatively little green matter grew and was ploughed in. The difficulty in growing a green manure crop where two crops of paddy are taken per year from the same land lies in the very short interval between the two crops for the growth of the green manure. All of the above green manure crops were put in after the paddy had been harvested and the land ploughed. In order to get over this difficulty, the seed of the green manure crop is now being sown in the paddy one or two weeks before the harvest, thus allowing for about three weeks' longer growth than under the system formerly practised on the farm. The result is shown on Plate II which is the photograph of a crop of sunn hemp grown in this way. This crop yielded cuttings at the rate of 2,600 lbs. of green matter per acre or 1½ times as much as the best yield given under the former system leaving out the first where a longer time was available for the growth of the crop. The above yields are for sunn hemp. Experiments on the use of cow pea as a green manure have also been begun and the yields of this crop have been decidedly larger averaging about

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[1] The cost of the sunn hemp seed has been charged for at market rates. Where the agriculturist grows his own seed, the cost on this source will, of course, be less.

4,000 lbs. of green manure per acre. The crop of paddy following this green manure is now growing and already shows the very beneficial effect of the dressing. We may safely conclude that, as even under the most unfavorable circumstances green manuring has proved profitable, the advantages of this practice are undoubted.[1]

We come lastly to the effect of the use of saltpetre. We see on looking at the figures that the effect has been so slight as to be quite negligible and that there has been a very great loss (Rs. 76-12-0 per acre for the three crops) as a result of the use of this manure. These results are in accordance with those obtained by investigators in Japan and Hawaii (*vide supra*, page 9 for references) and are distinctly opposed to the results published by the Departments of Agriculture in Bengal and Travancore.

If we now turn from the actual yields to those calculated on the basis of the relative fertility of the various plots, we find a fair degree of correspondence with the actual yields. The complete artificial fertiliser and the saltpetre plots still show a very large loss, while the gain on the green manure plots has been increased. The only marked change is in the castor plots where the calculated increased yields in two of the crops have been reduced so as to show a loss which is about counterbalanced by the increase in the other crop (Chintamani Sannabhatta for 1910).

A number of valuable conclusions can be drawn from the above results. (1) It is clear that the use of saltpetre cannot at all be recommended. The results from the use of this manure have been practically nil, while its high cost (Rs. 26 per acre) would warrant its use for paddy only in case a large increase in the yield could be thereby produced. (2) While the use of a complete artificial fertiliser produced a decided increase in the yield, that increase was quite inadequate to pay for the high cost of the fertiliser with the result that a great loss was incurred in its use. But we see from the results of the experiments with saltpetre that this is an unsuitable nitrogenous manure for paddy, so it is possible that this artificial fertiliser might have had the same effect on the crop if the saltpetre had been eliminated and only the basic slag alone or along with the sulphate of potash had been used. This would have reduced the cost of the manure per acre to Rs. 10 (basic slag alone) and Rs. 17 (basic slag + sulphate of potash) in 1910 and to Rs. 10 (basic slag alone) and Rs. 20-1-0 (basic slag + sulphate of potash) in 1911. If we suppose that both the phosphatic and potash manures have had a part in the increase of the crop, we see still that there would have been a total loss of over Rs. 18 per acre for the three crops while if the basic slag alone were responsible for the increase, a gain of about Rs. 8 for the three crops would result. We are, however, not warranted in supposing that the whole effect on the crop was due to the phosphatic constituent of the manure and must conclude, as far as our present knowledge is concerned, that the artificial fertilisers, while undoubtedly producing a decided increase in the yield, cannot be profitably used at present on account of their high price. Even had the use of the artificial fertilisers shown a distinct profit it would still be very questionable whether their introduction should, at present, be encouraged, as thereby the paramount importance of encouraging and extending the use of indigenous manures such as oil cakes, bone meal and green manures might be lost sight of. This subject has been very ably discussed by Messrs. Meggit and Birt of the Agricultural Department, Eastern Bengal and Assam, in a note on fertilisers presented by them at the last meeting of the Board of Agriculture in India. This note is to be incorporated in the Proceedings of the Board which will soon be issued; it should be read by every one who is interested in the development of agriculture in India.

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[1] See Appendix for the results of demonstrations of green manuring on paddy in Kadur and Shimoga Districts as well as for further results obtained on the farm.

From the above considerations, we see clearly that the greatest conservatism must be exercised in recommending manures for the use of raiyats. It has been rightly said that about the only record the average European or American farmer keeps is his bank book if he is fortunate enough to possess a bank account. He does not keep any accurate account of the cost of his various agricultural operations and trusts a good deal to his eye as to the results of a particular treatment, manurial or otherwise. What applies to the European or American farmer, applies with very much greater force to the average Indian raiyat or landholder. One of the first results of a little agricultural reading on his part seems to be the awakening of a strong desire to use so-called "scientific" manures which are supposed to have some particular, one might almost say magic, virtue. These he may purchase at a considerable cost. Just as in the above-noted experiment, these may yield a very decided increase and this he will no doubt at once see. On the other hand, it is very unlikely that he will keep any record that will enable him to decide at all accurately how much that increase has been. Even should he keep such a record he would have to base his comparison upon the crops obtained from two adjacent fields and he has no sure way of knowing whether those two fields were, before the use of the manure, of equal fertility. The chances are, therefore, that he may be using a manure costing him Rs. 25 or 30 an acre to produce an increase in yield worth not more than Rs. 10 or 15 and still be under the impression that he is actually making money by the use of the fertiliser. We thus see that nothing can be more foolish than the distribution of artificial manures for so-called experimental use by raiyats and land-holders. The necessity of experimenting under scientific control before any recommendations are made as to the use of any artificial and other commercial manures is perhaps nowhere so marked as in India, and in India nowhere more marked than in Mysore. (3) Castor in small quantities, such as those used in the above experiments, has a very decided effect upon the yield of paddy. It would, however, probably yield better results if it were applied along with bulky organic matter such as green leaves but this, as yet, remains to be tested. Under such circumstances, the amount could, no doubt, be reduced. It can, in all probability, be used profitably as a manure for paddy, but further results are required to settle this point definitely. In all likelihood castor cake could be replaced by other oil cakes such as, hongay, neem, safflower, etc., but no experiments as to the relative value of these various cakes as manures for paddy have, as yet, been carried out. (4) A green manure crop in the form of sunn hemp can be profitably used for paddy. Where, however, two crops of paddy per year are grown, satisfactory results can be obtained only by sowing the seed in the paddy some one or two weeks before the harvest. Cow pea, which is now also being tested on the farm as a green manure crop for paddy, seems likely to prove equally valuable. The Sesbanias (*S. aculeata and S. Egyptiaca*), which are extensively used as green manure crops for tea in Assam and which have been recommended by the Madras Department of Agriculture, have not made nearly so rapid a growth on the farm as either sunn hemp or cow pea and cannot, at present, be recommended. The same applies to several other green manure crops such as *Tephrosia purpurea*, *Crototaria striata*, etc., which have been recommended at various times. None of them has shown as good a growth as sunn hemp or cow pea, and there is, therefore, no reason for recommending their use in Mysore unless on the score of their not being so liable to be eaten by deer and other wild animals. This is no doubt a strong ground for testing such inedible leguminous plants as *Crotolaria striata* in the western part of the State where danger of damage by wild beasts is much greater than in the eastern part.

ROTATION EXPERIMENTS.

Paddy cultivation as commonly practiced throughout the State does not include any regular system of rotation. A certain amount of rotation is, however, practiced in some parts.

The commonest rotation is, without doubt, that of paddy with sugarcane. As sugarcane is, where properly grown, a much more profitable crop than paddy, the latter usually becomes of subsidiary importance, the most of the money for manures and cultivation being expended on the sugarcane. Such a rotation can, therefore, be better discussed in a consideration of sugarcane cultivation and its effects on that crop than in a consideration of paddy cultivation.

Occasionally white jola and fodder jola (*Andropogon sorghum*) are grown on paddy land, especially when it appears likely that the water-supply will not be sufficient for a paddy crop. In this case, the jola is grown from February to June under irrigation, while the paddy is grown as a Mungar crop from May to August.

Paddy land is also at times planted with plantains (*Musa sapientium*) which occupy the land usually for about three years. This is practiced more especially near towns where good prices can be obtained for plantain fruits and leaves.

Transplanted ragi (*Eleusine coracana*) is also grown as a summer as well as a rain crop in rotation with paddy in some parts and avare (*Dolichos lablab*) is sometimes grown mixed with the ragi. If the avare is not ripe at the time for planting the succeeding paddy crop, it is commonly ploughed in as green manure.

Garden crops such as tobacco, chillies, brinjals, turmeric, garlic and onions are at times grown in rotation with paddy on soils that do not become water-logged.

In localities where rice is sown in early May, Bengal gram, black gram, green gram and fenugreek are raised in the autumn and winter months. On the other hand, where transplanting of paddy is delayed until August, black gram, green gram, cow pea and sesamum are raised as an early crop sown at the advent of the Mungar rains. These crops are commonly looked upon as green manure crops in Mysore but, as the seeds are almost always removed, their value as a manure is very much lessened. This is commonly practiced in Mysore District. As these crops are grown immediately before the paddy, they might perhaps be more properly considered as catch crops than as rotation crops. In the same localities, horse gram, sunn hemp and niger are grown as green manure but even here a good deal of the green material is grazed off by the cattle. The question of the practice of green manuring in Mysore is discussed more fully in a bulletin on the subject which has already been issued.[1]

Under the Marikanave tank, almost every description of dry and garden crops is raised in rotation with paddy, the water rate being reduced when the land is devoted to dry cropping.

In considering all the above rotations, it must be remembered that the practice is not general throughout the State. Practically no definite information is available as to the effect of the rotations practiced. With regard to the growth of the leguminous crops, it is generally admitted that, even where the seeds are harvested, the effect upon the succeeding paddy crop is decidedly beneficial.

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[1] Green Manuring in Mysore, General Series, Bulletin No. 1, Mysore Agricultural Department.

TABLE VIII.

VARIETY CHINTAMANI SANNABHATTA.

	1910				1911			
	Yield per acre actual	Percentage increase	Yield per acre calculated	Percentage increase	Yield per acre actual	Percentage increase	Yield per acre calculated	Percentage increase
Unrotated paddy	890	...	1,020	...	1,340	...	1,530	...
Paddy after Bengal gram	1,335	50	1,530	50	1,545	15	1,770	16

To obtain accurate information on the value of a rotation of crops in paddy cultivation, experiments have been begun on the Farm. The alternate crop selected was Bengal gram. While the accompanying table (Table VIII) indicates that the rotation has been advantageous as far as the yield of paddy is concerned, the fact that only two isolated plots could be used for the experiment made the growth of the gram crop an economic impossibility. Bengal gram is peculiarly liable to insect attack and the result is that, when it is grown on small isolated areas, a large number of insects become concentrated on these patches and the crop becomes almost completely destroyed. A change has, therefore, been made involving the substitution of an irrigated variety of avare for the Bengal gram and as this crop is not nearly so susceptible to insect attack more favourable results are anticipated. The results so far obtained seem to indicate quite clearly that, at least in cases where two crops of paddy a year can be grown, the substitution of a profitable and suitable leguminous crop for the winter crop would be advantageous. Just what leguminous crop would be the most suitable can be decided only after further experimenting.

SEED SELECTION BY THE SALT WATER METHOD.

The salt water method of seed selection is a rough and ready method of selecting the heavier and more perfectly developed grains for seed extensively used in Japan. For this purpose, a solution of salt of a strength such that an egg to which a coin of about the weight of a three pie piece is attached will float in it is used. This is produced by a solution of approximately 1 seer of salt in 2 seers of water. When paddy is immersed in this solution a goodly portion of it floats. This is removed and only the grains which sink are used for seed after they have been washed in water to remove the salt.

The usefulness of this method is discussed in a paper published by T. Yokoi in the Japanese Imperial College of Agriculture Bulletin, Vol. III, No. 5. p. 42. The author points out what, of course, is obvious, *viz.*, that the sinking of certain grains does not prove that they are necessarily individually heavier than the grains which float. It simply shows that they are denser. A small and dense grain would sink where a large and less dense grain would float. As a matter of fact, in the case of paddy the denser grains are, at the same time, the heavier ones and this phenomenon the author explains by the supposition that the reason that a part of the grains float lies in the fact that those grains have not developed to fill up the enclosing hull which is formed before and independent of the grain. In this way, an air space remains between the grain and the hull and this causes the whole grain including the hull to have a lower specific gravity.

That it is, on the whole, the heaviest grains which sink is shown by the following figures which give the weights of 400 each of sunk and floating paddy grains of each of the two varieties experimented upon here, *viz.*, Doddabile Bhatta and Chintamani Sannabhatta. These were weighed after being dried to constancy.

Doddabile Bhatta—	
400 sunken grains weighed ...	... 9·2 grams
400 floating grains weighed ...	... 8·0 ,,
Chintamani Sannabhatta—	
400 sunken grains weighed ...	... 9·4 grams
400 floating grains weighed ...	... 7·9 ,,

At the same time, it was ascertained that a very much higher percentage of the sunken grains than of the floating grains germinated. Germination tests conducted in the laboratory yielded the following results :—

	Percentage germinated after 10 days
Doddabile Bhatta—	
Sunken grains	... 38
Floating grains	... 18
Chintamani Sannabhatta—	
Sunken grains	... 63
Floating grains	... 37

The results of these germination tests would seem, at first sight, to have very little practical importance for, where transplanting is done, only those seeds which germinate will eventually go over to the permanent plots. We may, however, presume with a good deal of probability that where the percentage of germination is low even the grains which do germinate will yield a smaller percentage of strong, healthy seedings than where the germination is higher. The seeds used in the above experiment showed an astonishingly low germination percentage and it is possible that where grain of a high germination percentage is used the differences in yield might not be so pronounced. On the other hand, the selecting out of heavier seeds should in any case produce a beneficial effect on the crop.

If any benefit does actually accrue from the use of seed selected in this way, it must be because the seedlings thereby obtained are stronger and healthier. It seems practically certain that a more fruitful method of improving a variety of paddy would be to start with individual strong plants of large yield and grow new strains from them, but this requires a great deal of painstaking and careful scientific work extending over a number of years and is quite beyond the powers of the average raiyat or landholder of Mysore. On the other hand, the salt water method is a rough and ready method which can be used by all and, if it really does bring about an increase in the crop, that advantage will be yielded at once.

The results of experiments extending over two seasons indicate clearly that selection of seed by the salt water method does lead to an increase in the crop. This is shown in the following table :—

TABLE IX.

	Doddabile Bhatta, 1910				Chintamani Sannabhatta			
	Yield in lbs. per acre		Per cent of increase		Yield in lbs. per acre		Per cent of increase	
	Actual	Calculated	Actual	Calculated	Actual	Calculated	Actual	Calculated
Unselected seed manured with castor.	1,090	990	...	...	1,950	1,770	...	...
Selected seed manured with castor.	1,440	1,350	34	36	2,245	2,080	15	18

If we consider the increase in value of the crop per acre we get the following results :—

	Increase by seed selection per acre		Increase in value	
	Actual	Calculated	Actual	Calculated
	lbs.	lbs.	Rs. a.	Rs. a.
Doddabile Bhatta	350	360	7 2	7 5
Chintamani Sannabhatta ...	295	310	6 7	6 12

The expenses incurred in selecting the seed are almost negligible a few annas covering the cost of the salt, which may be used again, while the value of the discarded seed is very slight and it may, in any case, be used for eating or may be sold.

It should be pointed out here that where seed thus selected is being used, the seed rate in the nursery should be reduced otherwise there is danger of the seedlings being injuriously affected by being too close together in the nursery.

While these seed selection experiments are being continued, the above results seem to be sufficiently conclusive to warrant the recommendation of this method of selecting more vigorous and healthy seed to the landholders and raiyats of Mysore in general. An effort will also be made to demonstrate its usefulness in different parts of the State during the coming year. It need hardly be pointed out that an increase in value of the paddy crop in Mysore of Rs. 6—7 per acre would mean an enormous increase to the agricultural wealth of the State.

SUMMARY OF CONCLUSIONS.

1. With regard to paddy cultivation, the view that better results can be obtained by ploughing the land immediately after harvest than by leaving the land in stubble and ploughing in puddle immediately before transplantation, appears to be erroneous.

2. Deep ploughing has not yielded uniformly better results than shallow ploughing in paddy fields and so cannot at present be recommended. A larger body of results

of experiments extending over several years more will be necessary before definite conclusions can be reached on this point.

3. Green manuring can be recommended as a cheap and efficient method of increasing the fertility of paddy lands. Where two crops of paddy a year are raised it is necessary to sow the green manure seed in the paddy some one or two weeks before the harvest to allow for a sufficient period of growth. Both sunn hemp and cow pea can be recommended for use as green manures.

4. Castor cake has not uniformly paid for itself as a manure for paddy in the experiments described here but a combination of small quantities of it with green manure would probably prove decidedly profitable. Other and cheaper poonacs might be profitably substituted for castor.

5. Saltpetre is not a profitable manure for paddy and has produced no decided increase in the yield over unmanured plots. It has been used uniformly at a great loss.

6. A complete artificial fertiliser composed of saltpetre, basic slag, potassium sulphate while producing a decided increase in the yield was, owing to the dearness of the manures, used at a great loss.

7. In general it seems fairly clear that organic manures rich in nitrogen which can be obtained cheaply or at a moderate price are the ones to be recommended for use in paddy cultivation. The results obtained by the use of milled fish in Madras bear out this statement. The use of costly artificial manures which, in the minds of many who have a smattering of information on agricultural subjects, have a special virtue, cannot at all be recommended in the light of our present experience. The use of bone meal as a manure for paddy has been shown to be advantageous in other parts of India and in Japan and might be tried with advantage here especially in connection with green manures. The use of lime in small quantities along with green manures is also a question which will receive the attention of the Agricultural Department in experiments now being planned.

8. The results of the rotation experiments are not such as to yield us definite information. It seems probable, however, that the rotation of paddy with a suitable leguminous crop would be profitable.

9. The salt water method of selecting paddy seed which is widely practiced in Japan appears to be a practical method for bringing about a decided increase in the yield which can be applied at very slight expense by any landholder or raiyat in Mysore.

SOME VARIETIES OF PADDY GROWN ON THE FARM.

In addition to the regular experiments already described in this bulletin, some preliminary work has been done on the growth of a number of different varieties of paddy which have been collected from various parts of the State as well as from other parts of India. The area which could be set apart for this work has been so small that the results cannot be considered as at all definite. It has been thought advisable, however, to give these results here as certain conclusions can, with reason, be drawn from them. The varieties were, for the most part, put in in plots containing one-thirtieth acre which were manured with cattle manure at the rate of 9,000 lbs. (about 9 cart-loads) per acre. In the case of one variety, Kallamuthan, a dressing of 15,000 lbs. per acre was used. In addition, for comparison the best yields that have been obtained on the Farm from the two local varieties, Chintamani Sannabhatta and Doddabile Bhatta are also given. These were obtained during the first year that crops were grown on the Farm after the land was acquired by Government and, in this case, the land was not given any manure at all. The accompanying table (Table X) gives the harvest results as well as the period of growth for each variety.

For the sake of convenience the varieties may be divided up as follows:—

1. Early maturing varieties (Nos. 1-5) requiring at Bangalore about four months to mature.

2. Medium and late-maturing varieties (Nos. 6-28) requiring roughly from four and a-half to six months to mature. These latter may be divided up according to quality, colour of grain, etc., as follows:—

(*a*) Inferior larger-grained varieties (Nos. 11, 18, 23, 27 and 28).

(*b*) Superior unscented varieties (Nos. 9, 10, 13, 14, 15, 19, 20, 21, 22, 25 and 26).

(*c*) Superior scented varieties (Nos. 6, 7, 8, 12, 16, 17 and 24).

If we, first of all, consider the early maturing varieties

TABLE X.

VARIETIES OF PADDY GROWN ON THE HEBBAL FARM.

No.	Name	Place from which the seed was obtained	Number of days taken to mature	Yield per acre	
				Cuttings lbs.	Grain lbs.
1	Kallamuthan (60 days' paddy)	Erode (Coimbatore).	115	...	2,430
2	Kuruvai	Tanjore ...	118	3,540	1,372
3	Garuda	Kolar ...	118	3,660	1,770
4	Bhangaratheege	Do ...	118	3,900	1,965
5	Aravadanallasambha ...	North Arcot ...	118	5,160	1,890
6	Raskadam	Central Provinces.	136	4,070	990
7	Nagpur, fine	Do ...	136	3,900	1,455
8	Ambemohur	Poona ...	144	7,250	2,875
9	Banku	Seringapatam ...	144	5,040	2,490
10	Banku (Shiyali)	Tanjore ...	144	6,000	2,880
11	Byra	Kolar ...	144	6,180	3,060
12	Kamod	Poona ...	144	3,375	1,375
13	Putti Sanna	Seringapatam ...	144	4,560	1,980
14	Chintamani Sannabhatta ...	Local ...	154	14,830	3,610
15	Dharapura	Seringapatam ...	159	7,260	2,745
16	Sukhadas	Do ...	159	4,500	1,680
17	Bhangarasarapani ...	Kolar ...	159	2,940	1,055
18	Nirmunugade	Do ...	159	7,320	2,962
19	Sakalati	Seringapatam ...	159	6,600	2,685
20	Bhangarabhala	Kolar ...	159	3,900	870
21	Haladi Sanna	Seringapatam ...	166	9,780	3,420
22	Gowri	Do ...	166	7,500	2,430
23	Karikal	Do ...	166	7,500	1,770
24	Jeerige	Do ...	166	5,640	2,040
25	Kembuti	Do ...	179	11,460	3,255
26	Pattasamanhalli	Do ...	179	12,780	2,490
27	Kaddi	Do ...	179	11,580	3,120
28	Doddabile	Local ..	180	10,685	3,795

(Nos. 1-5) we find that with the exception of the first (Kallamuthan), which was not grown during the same year and was given a very much heavier manuring, they have given yields decidedly below that obtained by the best of the later maturing ones. It must, in fact, be taken as fairly conclusive that the quick-growing paddies do not give a high yield and should be grown only where the supply of water is not sufficient to allow the later varieties to mature.

Of the medium varieties (Nos. 6-13), four have given very good yields. Ambemohur was, however, tried on only a very small plot and so should not be considered, while Byra is a paddy of poor quality. The two different Bankus have, however, done quite well and of all the varieties which have a medium period of growth they are the only ones which can, at present, be recommended for trial by landholders and cultivators who require a paddy of good quality which gives a fair yield and requires only a medium period for maturing.

The five and six months paddies which have been grown on the Farm have all been collected from different parts of the State. A number of them, notably Nos. 14, 18, 21, 25, 27 and 28, have given good yields but none of these have shown any superiority in this respect over the two varieties locally grown.

With regard to the varieties brought in from outside the State none of them has shown any marked superiority in yield over those grown in Mysore, with the exception of Banku obtained from Tanjore, while several of them were decidedly inferior in this respect. These results are, on the whole, in accord with those obtained in other parts of India where it has generally been found that varieties introduced from other parts have not done so well as those locally grown. It is necessary, therefore, to sound a note of warning in this connection as there is danger of much time and money being wasted by officials and Agricultural Associations in attempting to introduce such varieties without any preliminary testing. A much surer and scientifically sounder way of improving the paddies of Mysore, is by a careful selection carried out on indigenous varieties and the Agricultural Department hopes to take up this line of work in the near future.

1. EARLY MATURING VARIETIES.

These took 115 to 118 days. The quality of the rice is inferior and the yield rather poor. Kallamuthan has done well in the summer season. The value of these varieties becomes apparent under small tanks that fill early in the monsoon and dry up too soon for crops that take a longer time to mature. One of the varieties has shown that these may not succeed when shown late in the season, as the late sowings resulted in the production of empty grains. In this class are included :—

1. Aravadhanallasambha.
2. Kallamuthan.
3. Kuruvai.
4. Garuda.
5. Bhangaratheege.

1. *Aravadhanallasambha.*—This was obtained from North Arcot and matured in 118 days. It had a higher stand than all the other early maturing varieties and gave a cutting of 5,160 lbs. per acre. The ears were not proportionally large, giving a yield of only 1,860 lbs. of grain per acre. It yields a white rice.

2. *Kallamuthan.*—This variety (Kallamuthan or sixty-day paddy) was tried on a larger scale on one-third acre. The seed rate was $8\frac{1}{4}$ lbs. per acre. It matured in 115 days and yielded 2,430 lbs. of grain per acre. This was a summer crop. It did not do well as a rain crop.

It sometimes happens that tanks do not fill early in the season and the sowing is unusually delayed. To find out whether this early maturing crop would answer well when sown late it was sown on the 5th September but produced no seeds, the ears being almost all empty.

As an upland paddy it also failed entirely. This variety was obtained from Erode (Coimbatore) and yields a white rice.

3. *Kuruvai.*—This was obtained from Tanjore where it is usually sown mixed with Ottadai, a late maturing variety. When Kuruvai matures, the field is harvested and from the remaining Ottadai a second crop of rice is produced. On the Farm, only Kuruvai gave a crop while Ottadai failed entirely.

Kuruvai is supposed to be a 90 day crop, but it occupied 118 days at Hebbal. The yield was 3,540 lbs. of cuttings and 1,372 lbs. of grain and was the lowest of all the early maturing varieties. The rice is red and coarse and is thus inferior in quality.

4. *Garuda.*—This was obtained from the Kolar District and matured in 118 days. It is awned and has a dark skin with a mixture of yellow here and there. It thus presents two colours like "Garuda" or the Brahminy Kite. It yields a red rice of inferior quality, but did better than Kuruvai, giving a yield of 1,770 lbs. of grain.

5. *Bhangaratheege.*—This has a golden yellow husk and was obtained from Kolar. It matured in 118 days and yielded 3,900 lbs. of cuttings and 1,965 lbs. of grain. The grain is white and looks almost like that of Aravadhanallasambha from which it can scarcely be distinguished.

2. MEDIUM AND LATE MATURING VARIETIES.

(*a*) *Inferior large-grained varieties.*

Of these the Farm has tried :—

1. Byra.
2. Nirmunagade.
3. Karikal.
4. Kaddi.
5. Doddabile.

1. *Byra.*—This is an early maturing red rice and is consumed by the poorer classes. It matured in 144 days and has given a high yield, 3,060 lbs. of grain per acre. It can also be sown dry and grown as an upland paddy. It is preferred and grown largely because it matures early, yields well under indifferent conditions and does not suffer much from insufficiency of water. This is grown both in Bangalore and Kolar Districts. The trial seed was from Kolar.

2. *Nirmunagade.*—This is a coarse red variety, got from Kolar. The peculiarity of this is that it can be grown in tank beds or areas that become submerged. The seed has to be sown when the land is fairly moist and not swampy and, if the plants are a few inches high, no amount of water will injure the crop. It is said that it will grow above the water level even when the water is 8 feet deep. People are known to have harvested the crop in ferries. It is something like the Tadaungbo of

Burma. It took 159 days and yielded 2,962 lbs. of grain per acre.

3. *Karikal.*—This is an inferior rice with a dark husk, obtained from Seringapatam. It took 166 days and gave the poor yield of 1,770 lbs. of grain per acre. It is a red rice.

4. *Kaddi.*—This is a white coarse-grained variety got from Seringapatam. The rice becomes badly broken during hulling. It took 179 days and yielded well, *i.e.*, 3,120 lbs. of grain per acre.

5. *Doddabile.*—This is the local white-grained variety. The grains are large. It took 180 days and the best yield on the Farm was 3,795 lbs. of grain per acre. It can be sown dry and can also be grown as an upland paddy. Tried as an upland paddy it took 183 days and yielded 809 lbs. of grain per acre. This shows that without a fair quantity of water it attains only a precarious growth.

(*b*) *Superior unscented varieties.*

The following have been tried on the Farm :—

1. Banku.
2. Pulli sanna.
3. Dharapura.
4. Sakalati.
5. Bhangarabala.
6. Haladi sanna.
7. Gowri.
8. Kembuti.
9. Pattasamanahalli.
10. Chintamani sannabhatta.

1. *Banku.*—Two samples of this variety were got, one from Shiyali in Tanjore and the other acclimatised at Seringapatam. The Shiyali seed produced 2,880 lbs. of grain and that from Seringapatam 2,490 lbs. of grain per acre. It matured in 144 days. It has a long grain and the rice is as long as that of Singapur sold in the bazaar. It gets somewhat broken during hulling, is the coarsest of the superior types of rice and has a light coloured husk.

2. *Pullisanna.*—A superior variety got from Seringapatam. It has yielded poorly giving 1,980 lbs. of grain per acre. It is also a long-grained variety and finer than and superior to Banku. It has a golden yellow husk.

3. *Dharapura.*—This is a variety that was originally introduced from Dharapura (Coimbatore) in South India into Seringapatam and was got for trial in the Farm from the latter place. It matured in 159 days and yielded 2,745 lbs. of grain per acre.

4. *Sakalati.*—This was got from Seringapatam. It is the best of the lot in quality and has a reddish hull which gives to it the name "Sakalati" (red broad-cloth used as a blanket). It took 159 days giving a yield of 2,685 lbs. of grain per acre.

5. *Bhangarabala.*—An awned variety, got from Kolar, did very badly on the Farm; it yielded only 870 lbs. of grain per acre, though occupying a period of 152 days. It derives its name from its having a yellow husk and awn.

6. *Haladisanna.*—This is a fine-grained variety got from Seringapatam which produced the high yield of 3,420 lbs. of grain per acre. Considering the quality of the rice, it is probably the best of all the varieties tried on the Farm. It matured in 166 days and has a yellow husk; hence the name "Haladi" (yellow) is given to it.

7. *Gowri.*—This is a small-grained variety, obtained from Seringapatam. The period of growth was 166 days and the yield 2,430 lbs. of grain per acre. The grains are small and flat and not so plump as those of the other varieties.

8. *Kembuti.*—Kembuti or the red-tipped as the name implies, got from Seringapatam, yielded next to Haladisanna. Though taking 179 days, it has yielded 3,255 lbs. of grain per acre. The grains are of the flat and round type and are thus not much esteemed for quality.

9. *Pattasamanahalli.*—This was got from the village of that name in the Seringapatam Taluk. It produced a rank growth of leaf but did not yield so much grain. Besides it was damaged somewhat by birds and some grain was lost thereby. On account of these causes, the yield was brought down to 2,490 lbs. per acre. It took 179 days for its growth.

10. *Chintamani Sannabhatta.*—Also called Bhangarakaddi Sannabhatta. This was originally brought in from Chintamani but has now been locally acclimatised. It can be grown both in the rainy and summer seasons. It took 154 days and yielded at its best 3,610 lbs. of grain per acre. It has a yellow skin and an elongated shape and has hence been given the name "Bhangarakaddi."

(*c*) *Scented varieties.*

These have a peculiar odour when cooked and are very much liked by some people. They also fetch high prices. Their yields have, however, for the most part been low even where the variety has taken 166 days to come to maturity. Under this class come:—

1. Raskadam.
2. Nagpur fine.
3. Ambemohur.
4. Kamod.
5. Sukdas.
6. Bhangarasarapani.
7. Jeerige.

1. Raskadam.—Obtained from the Central Provinces. The grains are small and have a reddish spot on the hull. The rice is fine and superior. The yield was only 990 lbs. of grain per acre and the period of growth was 136 days. The rice is of the round type.

2. Nagpur fine.—This is an awned variety which was got from Nagpur and is supposed to grow without much water. The rice is of the elongated type, fine and very superior. It yielded only 1,455 lbs. of grain per acre. The period of growth was 136 days. Tried as an upland paddy in the rainy season in the garden area, it failed entirely even when irrigated during the breaks in the monsoon. In the summer season, it was manured with 1,000 lbs. of white castor and 10,000 lbs. of farm yard manure and was irrigated every fourth day. Under these conditions it produced 2,537 lbs. of grain per acre.

3. Ambemohur.—This was obtained from Poona and is one of the best rices grown in the Bombay Presidency. It took 144 days and yielded 2,875 lbs. of grain. It ranks first among the scented varieties. As it was tried on a very small area, the results cannot be accepted as at all conclusive. The rice is fine-grained and superior and belongs to the round type. It is, however, coarser than Sukdas, Bhangarasarapani and Jeerige.

4. Kamod.—This was also obtained from Poona. It is the coarsest-grained amongst the scented varieties. The rice is of the elongated type and though perhaps on a par with paddies of the unscented superior class, is inferior to the other scented rices. The yield was also poor, being only 1,375 lbs. of grain per acre. The period of growth was 144 days. Tried, as it was, on a very small area, the results require further confirmation.

5. *Sukdas.*—This is a fine-grained, scented rice got from Seringapatam ; it took 159 days giving a poor yield of 1,680 lbs. of grain. The hull is light-coloured and the rice white. The grain is more elongated than those of Bhangarasarapani and Jeerige.

6. *Bhangarasarapani.*—This is an elegant-looking, fine-grained, scented variety got from Kolar. The husk is reddish. It took 159 days and gave the poor yield of 1,055 lbs. per acre. The rice is of the round type and being the smallest of the varieties has a most prepossessing appearance. It, in common with Jeerige, will bring the highest price.

7. *Jeerige.*—A variety greatly resembling the above, was got from Seringapatam. It took 166 days and yielded 2,040 lbs. of grain.

APPENDIX.

SOME RESULTS OF DEMONSTRATIONS OF GREEN MANURING AND SINGLE SEEDLING TRANSPLANTATION IN KADUR AND SHIMOGA DISTRICTS.

As a result of a tour of inspection in the western part of the State during the autumn of 1910, it was decided to carry out demonstrations of single seedling transplantation and green manuring for paddy at various centres in the western part of Kadur District and the south-western part of Shimoga District. Later in the spring of 1911, similar work was taken up in co-operation with the Kadur District Agricultural Association in villages in the neighbourhood of Chikmagalur. The results are, at the time of going to press, only partially available but as those which have been received are decidedly interesting I have thought it desirable to include them here.

Single Seedling Transplantation.

The areas that were available for single seedling transplantation were usually small but, as far as possible, areas of about one-tenth acre were selected. These have, in each case, been compared with equal areas near by which have been transplanted according to the local custom. The number of seedlings usually planted together differs very greatly in different parts, varying from about seven seedlings per bunch at Yedahalli to about forty per bunch at Agumbe. The reason usually given for planting such a large number of seedlings together is the danger of the seedlings being washed away by the heavy monsoon rains. In only one case was this difficulty experienced in the single seedling plots, *viz.*, at Nalur where replanting had to be done. It must be remembered, however, that where one officer has to conduct demonstrations of this character over a tract over thirty miles wide he cannot stop and choose the most favorable weather for transplanting in any one place.

The following table gives the results of the single seedling transplantations as far as they are up to the present available :—

Place	Extent of each plot	Single seedling transplantation		Local transplantation		Percentage of increase by former practice	
		Grain and straw	Grain	Grain and straw	Grain	Grain and straw	Grain
	Sq. ft.						
Lakkavalli ...	4,968	1,872	472	1,472	462	27	2
Yedahalli ...	4,500	1,473	412 Not threshed	1,287	390 Not threshed	14	...
Agumbe ...	1,525	228	169	196	148	16	14
Nabala ...	5,325	503	347	462	317	9	9
Megarvalli ...	950	360	264	290	174	24	52
Nalur ...	950	400	150	225	75	77	100
Ajjamkere ...	2,700	360	257	350	227	3	13
Tirulebile ...	4,648	423	297	396	263	7	13

An examination of these figures shows throughout an increase of crop as a result of transplanting single seedlings. In two cases, the difference has been very large indeed but, as in these cases the demonstration plots were very small (about $\frac{1}{50}$ acre), the figures lose a good deal of their value. However, in the other cases the difference in yield has been quite sufficiently marked to show clearly the superiority of single seedling transplantation and many of the landholders on whose lands these demonstrations were carried out have expressed their intention of going in for this method of planting on a larger scale during the coming season.

Green Manuring Demonstrations.

The green manuring demonstrations were carried out on a larger scale, an acre being sown with the green manure seed (Sunn hemp) in all cases where the returns are at present available. The plots given by the owners for sowing the green manure seed were usually very poor ones that had had little or no manure the previous year. In the demonstrations here recorded, the green manure seed was sown almost immediately after the paddy harvest in December-January and was ploughed in after the early spring rains. In other cases, the green manure was sown after the early spring rains and ploughed in a week or so before transplantation. In the extreme west of the State, the early spring rains are rather uncertain and where there has been a delay in sowing the green manure crop owing to failure of early rains, it is likely to be drowned out by the heavy monsoon rains in the first or second week of June. This is the reason why the seed was sown soon after the harvest of the paddy.

The available results are given in the following table :—

Place variety of paddy	Period of growth	Extent of green-manured & check plots acre	Yields on green-manured plots		Yields on check plots under local treatment		Percentage increase by green manuring
			Grain and straw	Grain	Grain and straw	Grain	
		Acres	lbs.	lbs.	lbs.	lbs.	
Yedahalli ...	178	1	17,416	4068 Not threshed	12,432	3875 Not threshed	40
Agumbe ...	186	1	7,500	,,	5,600	,,	34
Nabala ...	188	1	5,627	3,060	3,376	1372 ,,	66
Megarvalli ...	188	1	10,685	3,975	9,780	3,620	9
Tirulebile ...	191	1	4,823	2,372	3,564	1476 Not threshed	35

It will be noticed that yield of grain for only a part of the plots is given. This is because, at the time of going to press, threshing has not been completed and the yield for the other plots is, therefore, not yet available.

A word of explanation with regard to the manuring of the check plots in this series of demonstrations is necessary. These check plots were not ones that received no manure whatever but ones which received cattle manure at the rate of 8 to 12 cart-loads per acre. So the results of the application of green manure are even greater than are indicated by the figures. The fact must be emphasized that it is only in very rare cases that a landholder or raiyat has or is able to obtain sufficient cattle manure to manure all his paddy land in any one year and it is, in fact, a usual custom to apply the cattle manure to one-third or one-half the area to be planted in paddy and then the following year or years to manure that part which was not manured the year before. In this way, the land receives an application of manure once every two or three years. Thus we see that, even if the green manure produced no greater effect than the cattle manure, still its use would be of great value for, by means of it, agriculturists are enabled to manure all their land every year and thus can keep it at a high state of fertility. Probably the best plan would be to apply the cattle manure at the rate of about fifteen cart-loads per acre to as much land as can be treated with the stock available and to sow a green manure crop on the remaining paddy land. In order to preserve a green crop from the depredation of wild beasts, which are, of course, more numerous in the western part of the State, it is necessary to put a fence around it and the plan suggested above would reduce the cost of fencing in any one year to the lowest amount possible. The cost of fencing has been variously estimated at from Rs. 3 to Rs. 5 per acre. The latter figure is certainly too high and it must also be remembered that when once fencing materials have been gathered they can be kept and used year after year. Even with the cost of fencing at Rs. 5 per acre I feel certain that the growing of a green manure crop would pay. It is possible, however, that it would pay better in those parts where danger of damage by wild beasts is great, to sow an inedible leguminous weed, like *Crotolaria striata* even though it does not add as much nitrogen to the soil. Tests to settle this point will be carried out during the coming season.

The results of this demonstration work must be considered as very satisfactory, both as regards green manuring and single seedling transplantation. The results from the remaining plots in villages near Chikmagalur, where the harvest has not yet been completed, promise to be equally satisfactory. This extremely important work will be continued and extended just as rapidly as the staff available for the purpose will admit and efforts are being made to enlist the co-operation of Agricultural Associations and individual landholders to as great an extent as possible.

A still more striking example of the beneficial effects of green manure for paddy is given by some results just obtained on the Farm. In the case of two very uniform plots on which paddy is being grown in rotation with sugar cane, one plot was sown with cow pea as a green manure while the other was left unmanured. The green cuttings of cow pea amounted to 10,900 lbs. per acre and the resulting yield of paddy was at the rate of 2,830 lbs. of grain per acre. On the unmanured plot, the yield of paddy was only 1,320 lbs. of grain per acre, so in this case the sowing and ploughing in of a green manure crop has more than doubled the yield of paddy. In this case of course, only one crop of paddy was taken from the land in a year, so that the green manure crop had a very much better opportunity to grow than was the case with the experiments mentioned in the body of this bulletin.